Do No Harm:
Are Your Monitor Wells Making the Problem Worse

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State Water Resources Control Board
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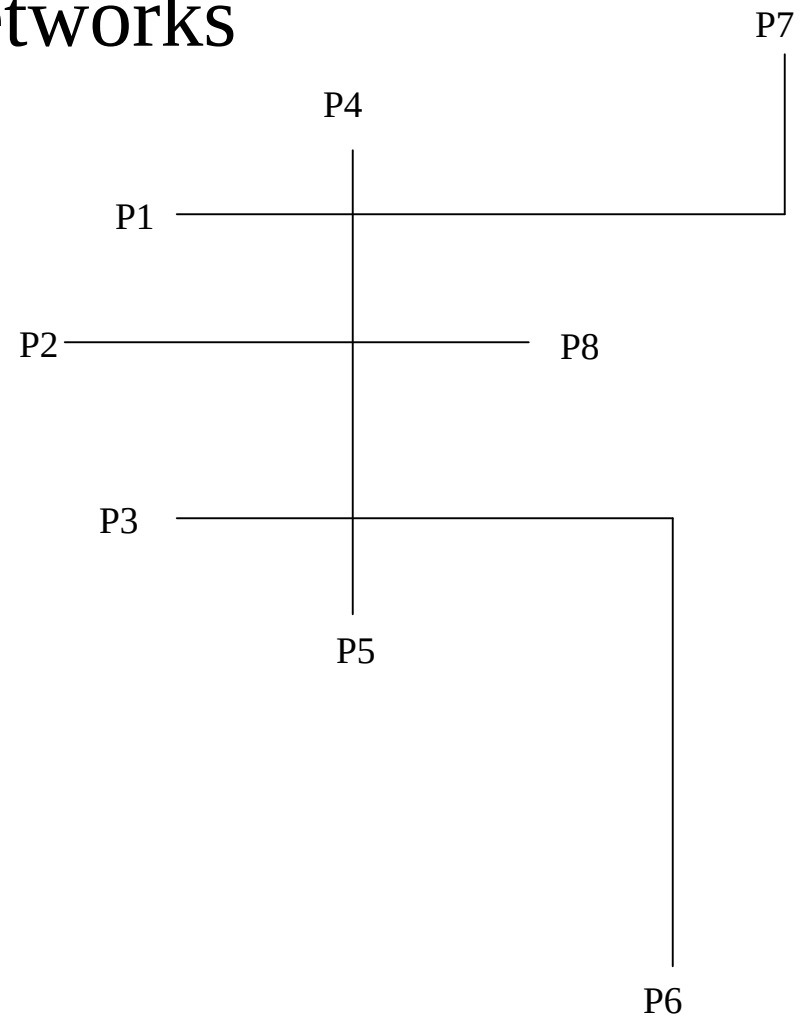
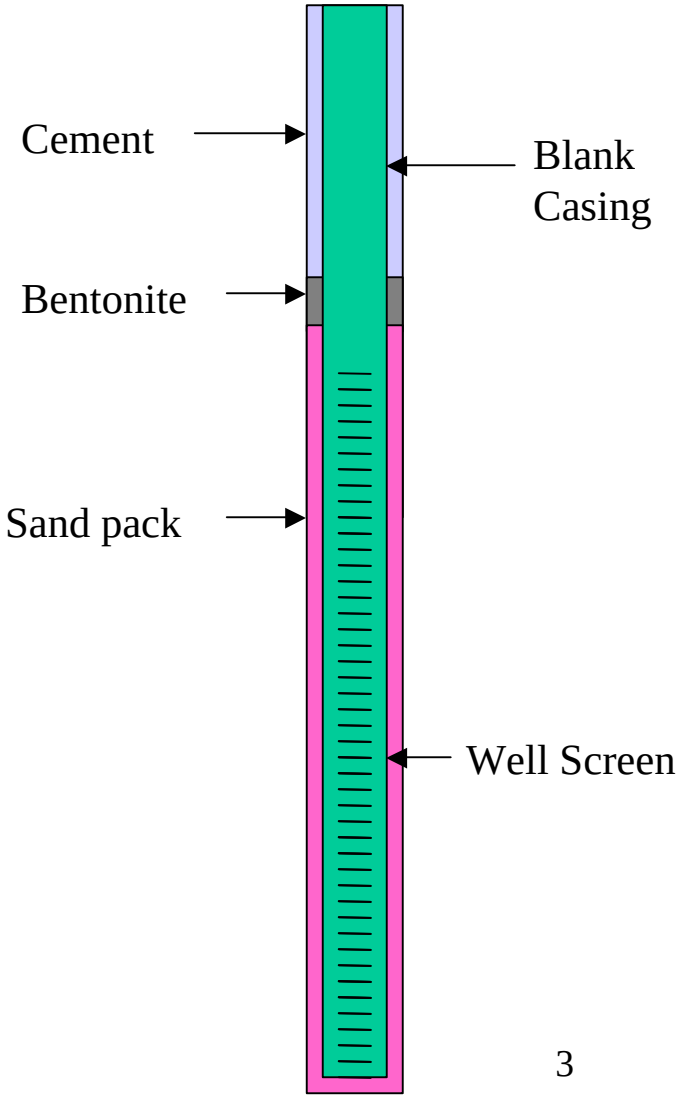
Pipe Networks

- Different pipes may have different diameters and lengths, therefore different resistance to flow
- The entrance/exit pressure of each pipe may be different
- The amount of flow and direction of flow will vary depending on the values of the different variables



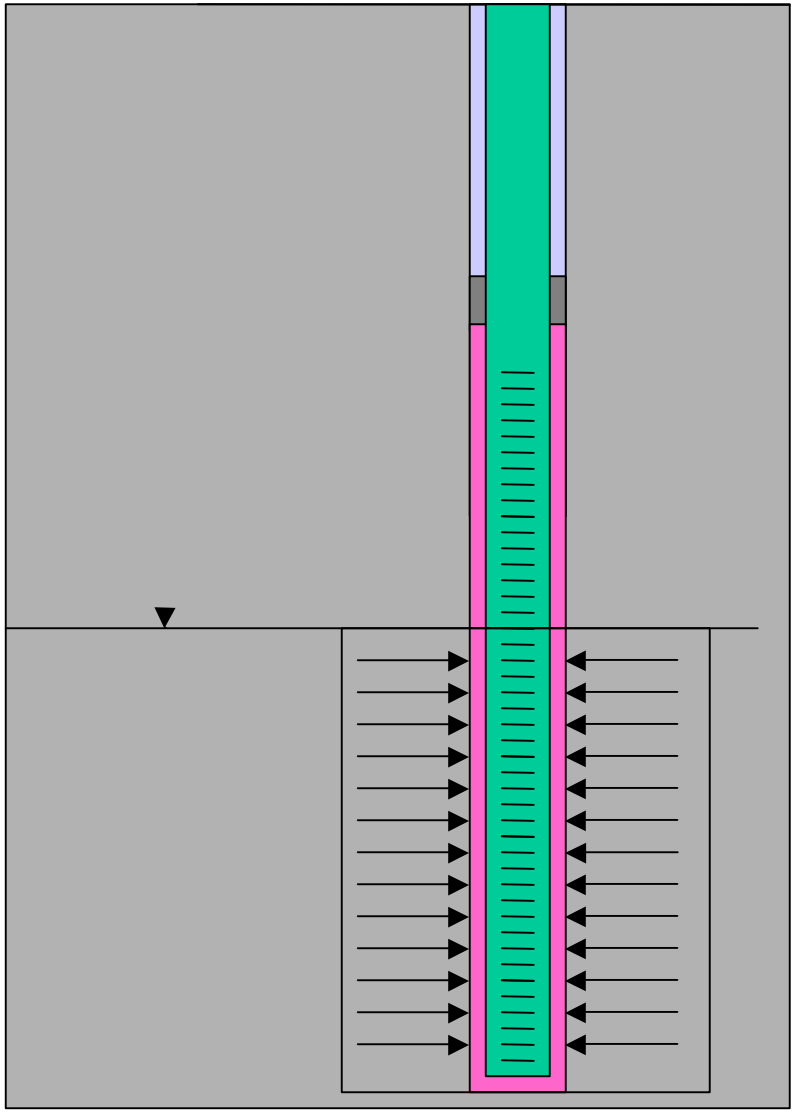
When a well is installed

- a hole is drilled in the ground
- a pipe, slotted at the bottom, is placed in the hole
- sand is pored around the pipe to the top of the slots
- bentonite is placed around the pipe at the top of the sand, then hydrated
- cement grout is poured into the hole, around the pipe, filling to the top



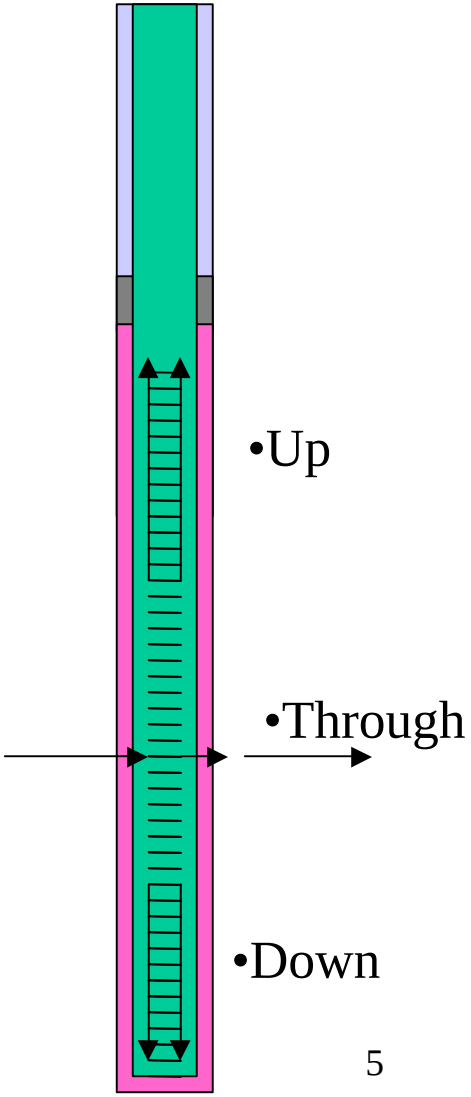
Old conventional wisdom: Wells are like big buckets

- Water in the casing is stagnant and not representative of the formation until purged
- Volatiles rapidly evaporate from the stagnant water surface in the well
- Therefore, water in top of well is depleted of volatile compounds
- Wells recharge uniformly from the formation after purging
- Consistent concentration of contaminants from top to bottom of well after purging



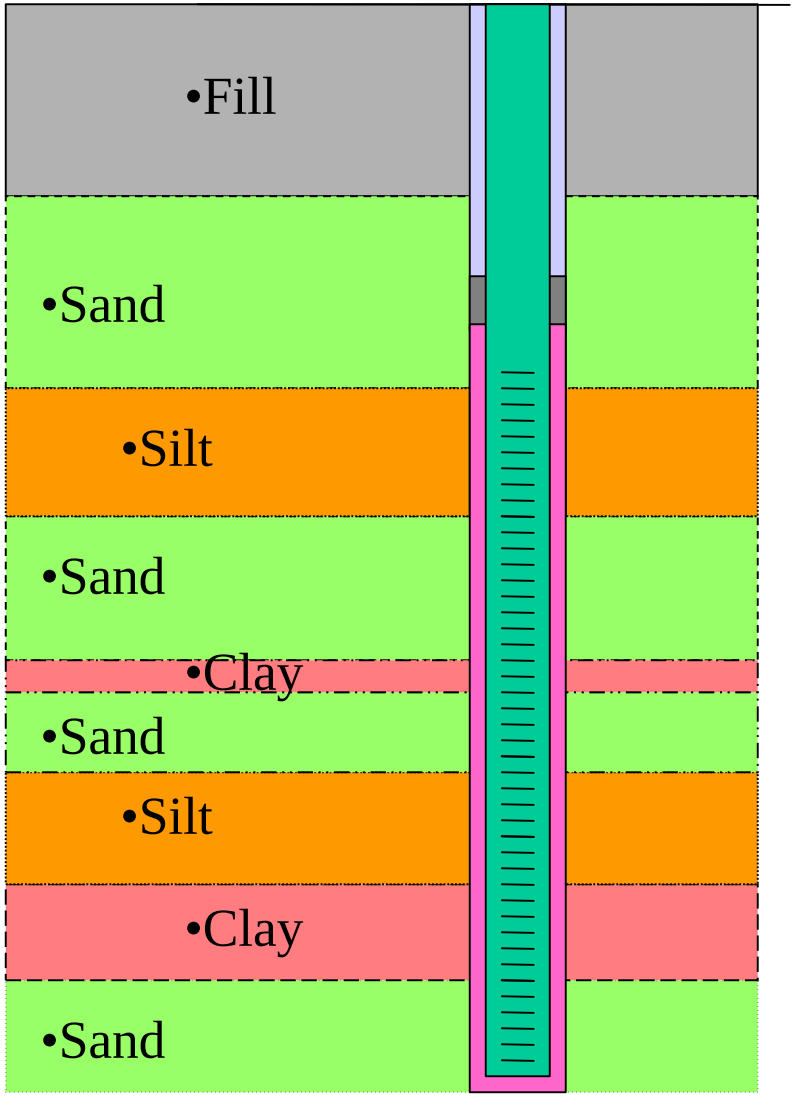
Bold Assertion #1: Wells are like pipes

- Well casing has very low resistance to flow (compared to formation)
- Water in a well is dynamic
- Water flows horizontally and vertically
- Flow in the well casing responds to very small pressure differences



Bold Assertion #2: True homogeneous environments don't exist in nature

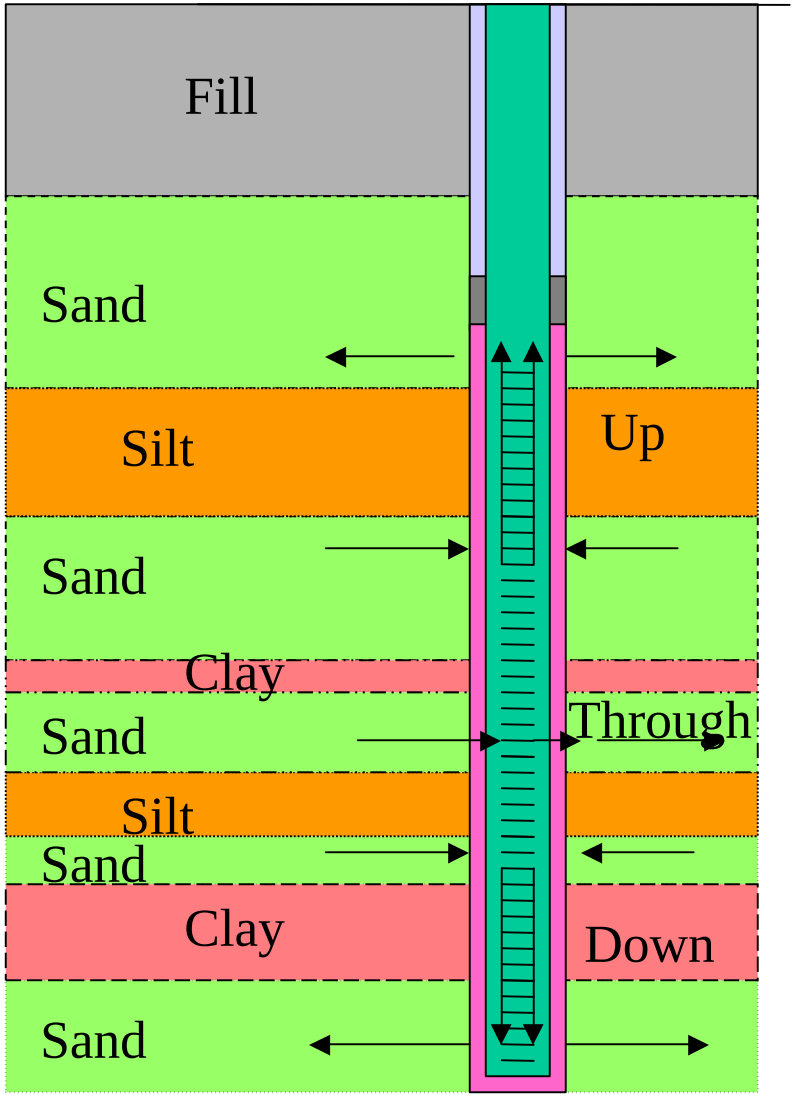
- The concept of homogeneity is a simplification used to make situations easier to understand
- Even controlled plume studies in "homogeneous" aquifers show surprisingly erratic behavior
- Answers will be accurate enough if the scale of the hetergeneities is small compared to the situation being studied
- If the heterogeneities are not small relative to the situation, they will skew results in unexpected ways



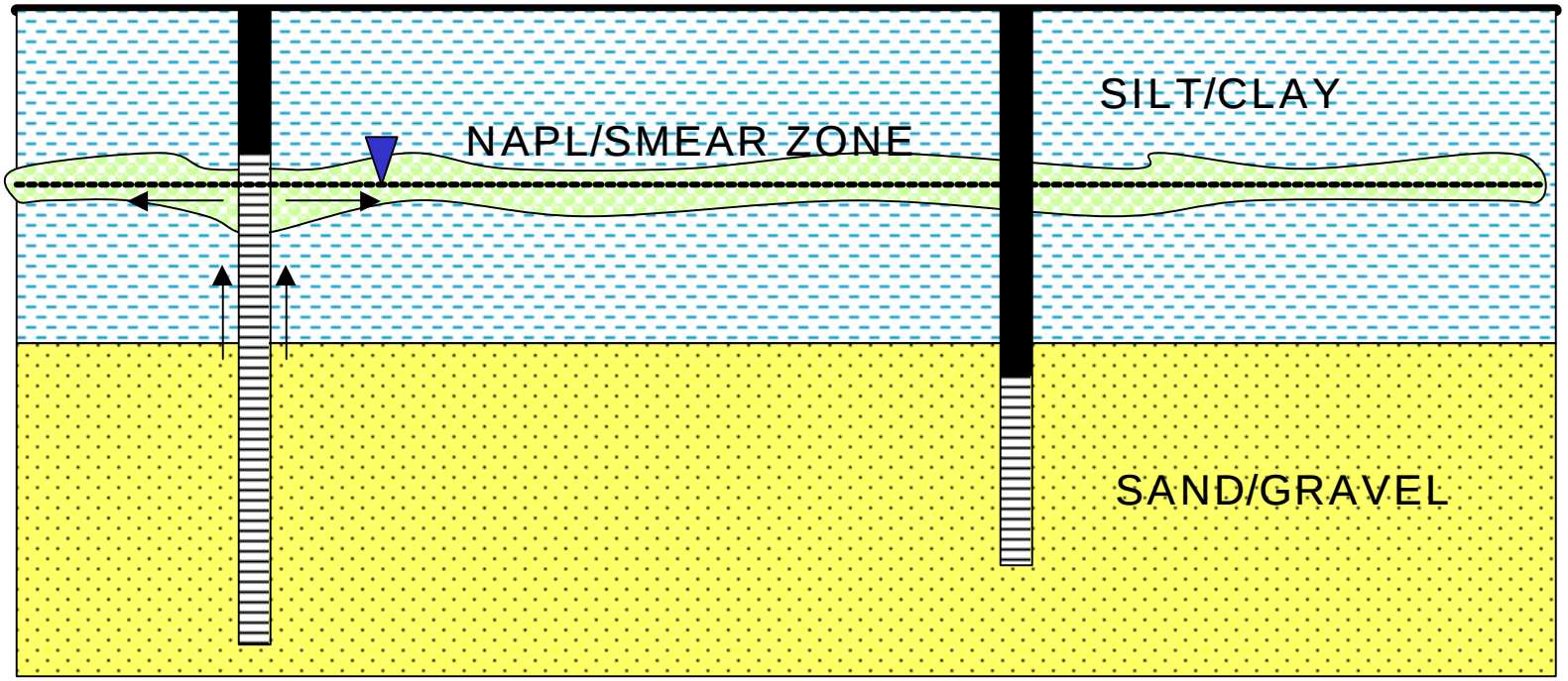
New math

Wells are like pipes + True homogenous environments don't exist in nature = ?

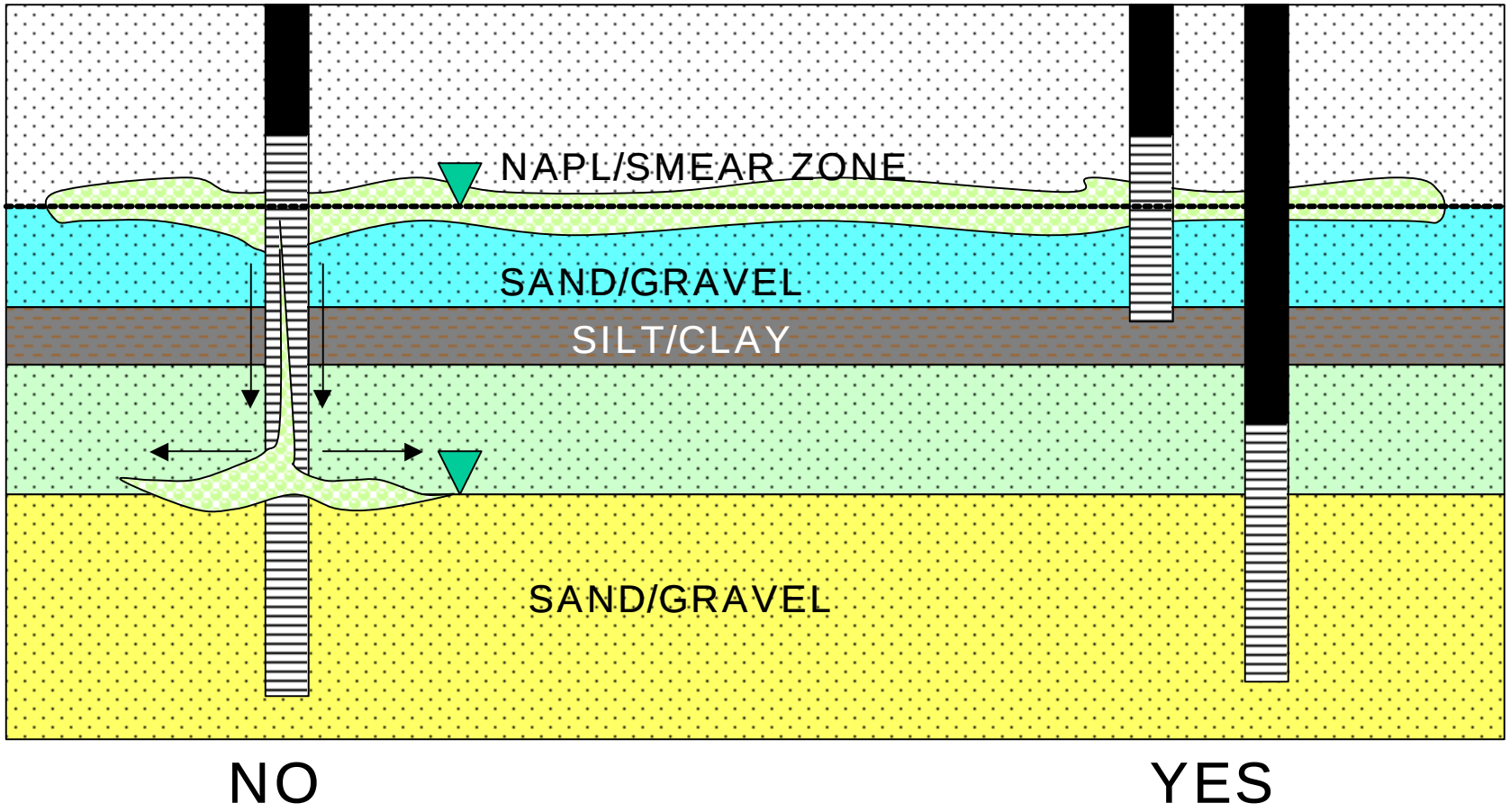
- Samples taken from wells are a blend of water from different strata
- Samples may not be representative of the strata you are interested in
- Wells may be acting as conduits for contamination to flow to deeper strata
- Water may be rising through wells into contaminated soil
- Purging before sampling may do more harm than good



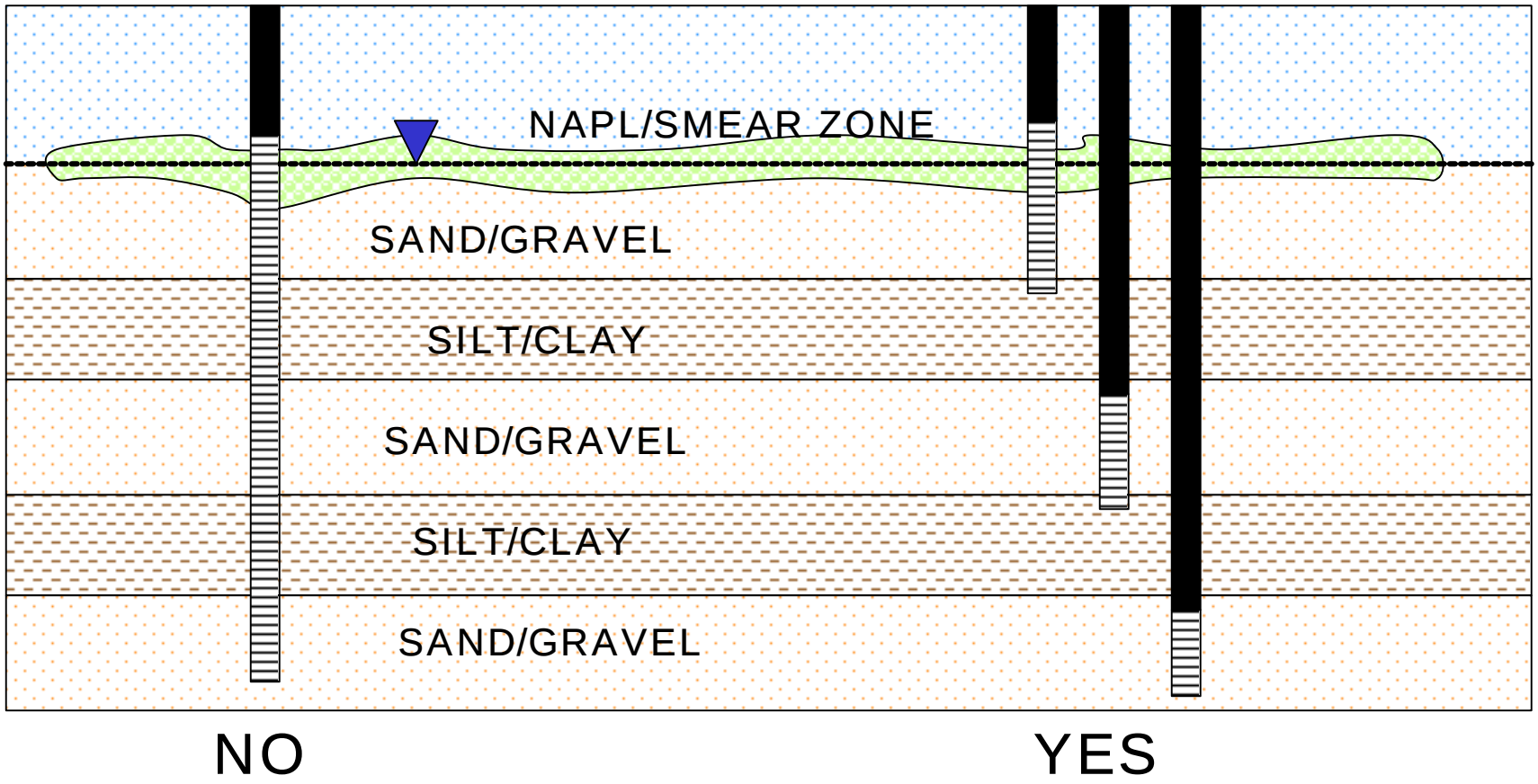
CONFINED/SEMI-CONFINED GROUNDWATER



PERCHED/WATER TABLE



STRATIFIED SAND AND SILT/CLAY



How can we do better?

- Continuous core rather than samples every five feet
- Short well screens (5ft? 10ft?)
- Nested wells (shallow and deep)
- Test for vertical flow in suspect wells (long well screens, heavy pumping areas, etc.)
- Verify selected boring logs with CPT, e-log, or ??
- Destroy badly constructed wells
- Consider “no-purge” sampling

Words to consider...

Groundwater samples we send to a lab may be just a few milliliters in a VOA vial. Try to have a good understanding of where that water really came from, the journey that it took, and what it really represents.

Wells transmit groundwater (and contamination) when they are being sampled and each of the 89 days of a quarter they are not being sampled. Don't install wells that transmit it very far.

Downhole Flow Studies

- Recent study of four central valley sites found a shallow monitor well with a downward flow of 1/2 ft/min.
- SWRCB to undertake a statewide study of flow in monitor wells later this year